

BUOY TECHNOLOGY DEMANDS, DEVELOPMENTS, OPERATIONAL CHALLENGES AND FORECASTING IMPROVEMENTS IN INDIA

by

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Ocean Observation Systems

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Ocean Observation Systems

This program covers the development and deployment of different observation systems such as

- Moored buoys
- Tsunami system

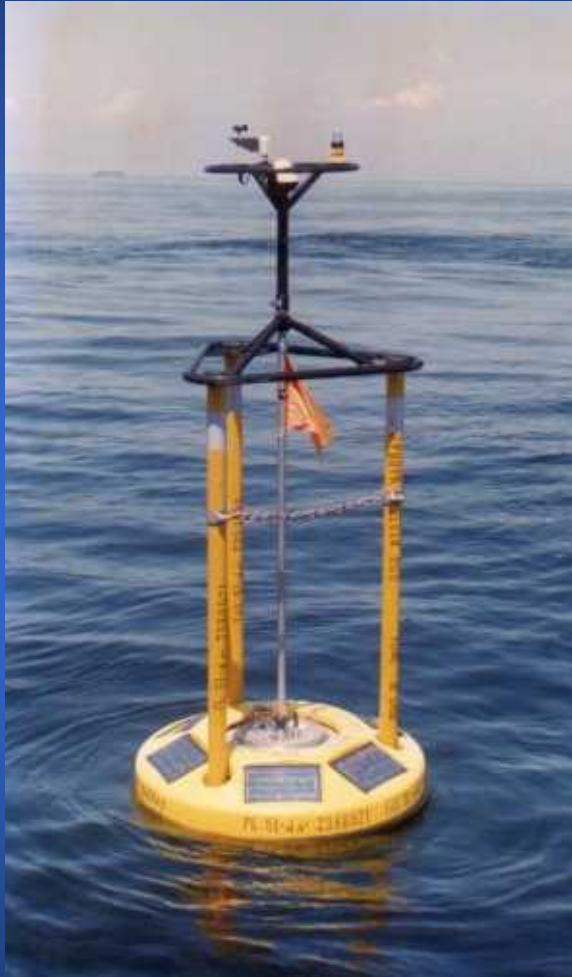
National Data Buoy Programme (NDBP)

- NDBP was implemented in 1996 in collaboration with Oceanor Norway to establish 12 moored buoy network in Indian seas
- Two kind of buoy systems were acquired from Oceanor
 - Wavescan & Seawatch

Objectives

- To collect met-ocean parameters in Indian seas
- To improve weather and ocean state prediction
- To generate and supply data and its products
- To monitor the marine environment
- To improve buoy technology
- To validate satellite data

Buoy Technology Acquired



Seawatch buoy

Characteristics

- Weight : 450 kg
- Height : 7.5 m
- Diameter : 1.76 m

Sensors

- Air Temperature
- Air Pressure
- Wind Direction
- Wind Speed
- Wave Height
- Wave Direction
- Current Speed
- Current Direction
- Water Temp
- Conductivity
- Oxygen
- Chlorophyll
- Hydro carbon

Buoy Technology Acquired

Characteristics

- Weight : 924 kg
- Diameter : 2.8 m
- Max height : 6.75 m

Sensors

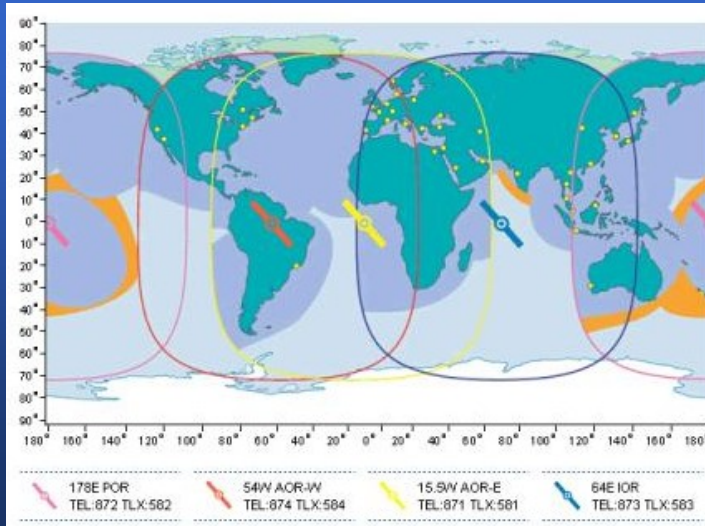
- Air Temperature
- Air Pressure
- Wind Speed
- Wind Direction
- Wave Height
- Wave Direction
- Surface Currents
- Water Temp.
- Conductivity



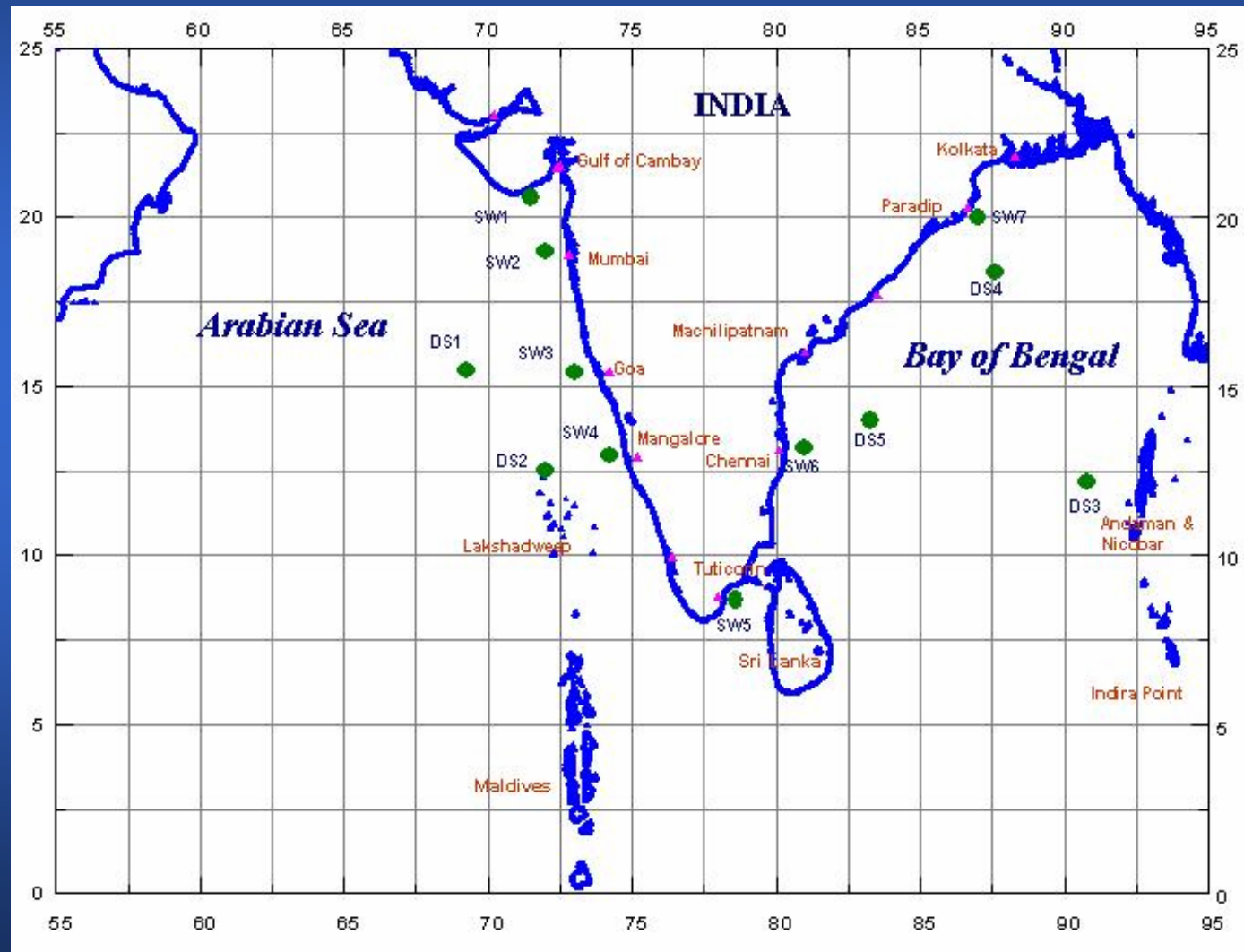
Wavescan buoy

Satellite Communication

Real time Geo-stationary satellite INMARSAT has been used for data transmission



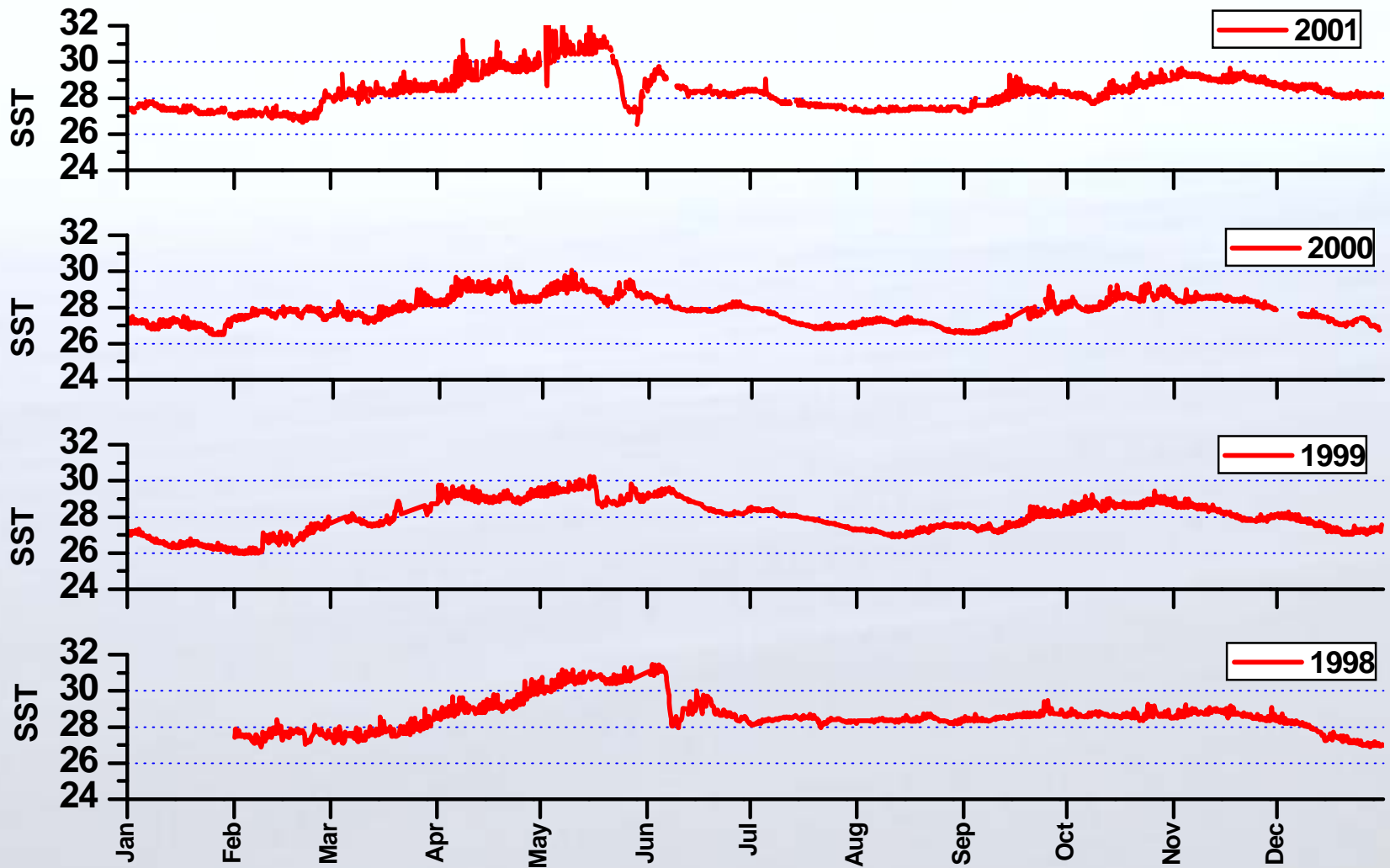
12 Buoy Network Achieved(1997 to 2002)



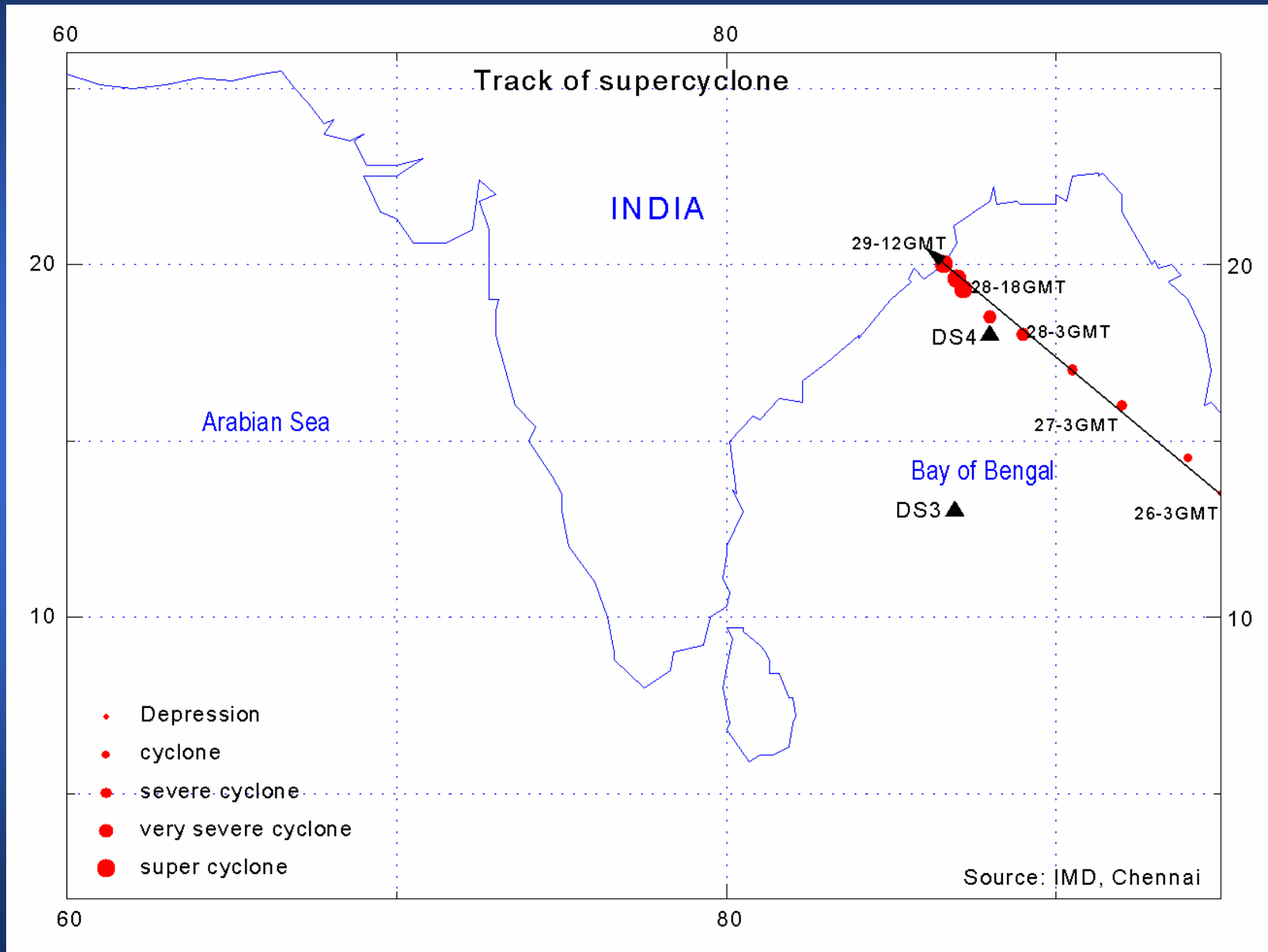
Data Quality

- Data Quality was good
- Continuous long term measurements were obtained
- Extreme Events were captured and the data was useful for cyclone warning

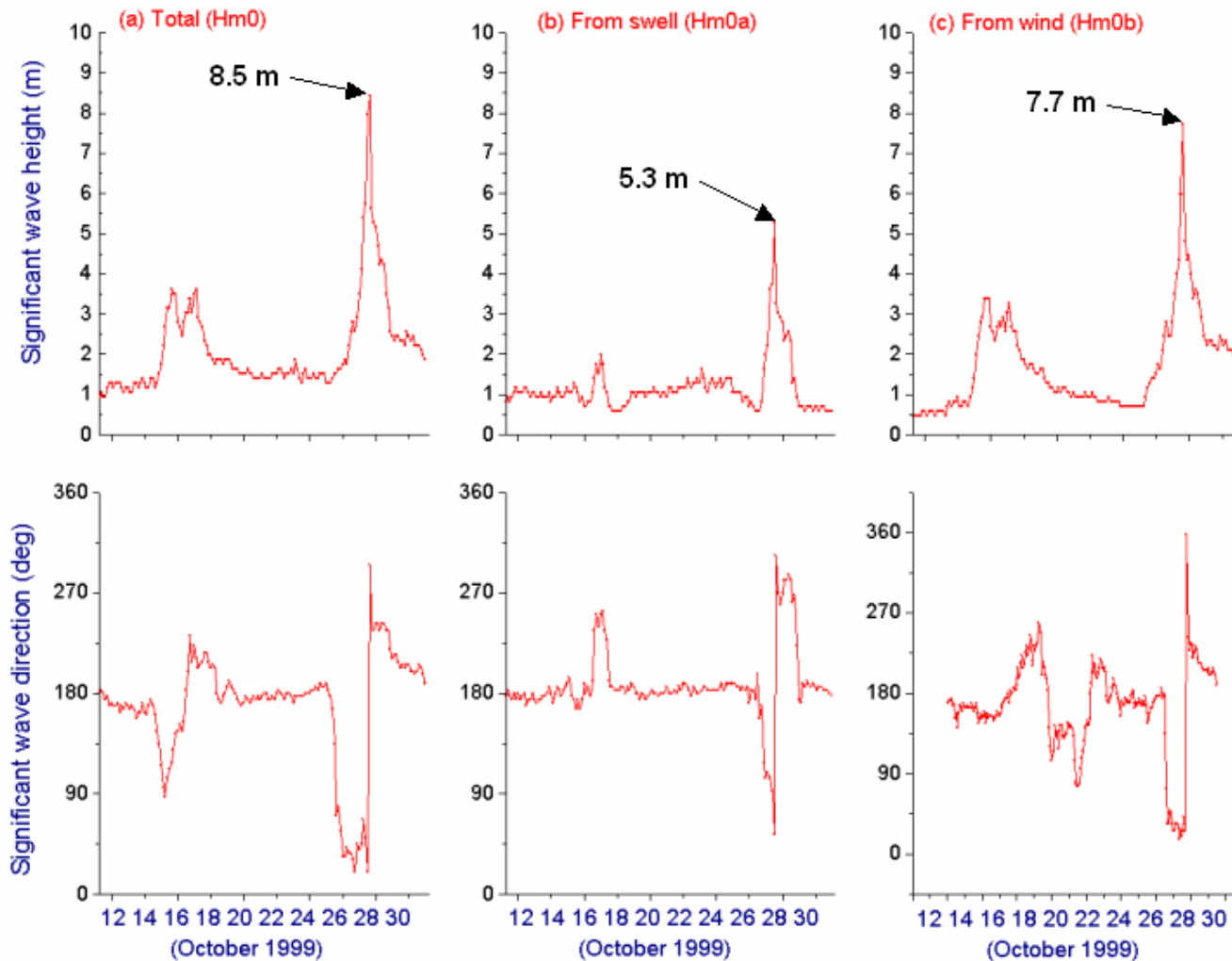
SST Observation in Central Arabian Sea by DS1 Buoy



Super Cyclone in Bay of Bengal (October 1999)



Super Cyclone Wave Observations



Significant wave height (8.4 m) and direction (NE) observed during the Super Cyclone (October '99) from the buoy deployed off paradip (DS4)

Near Real Time End Users Of Buoy Data

Sl. No	End User	Place	Data Supply	Use
1	India Meterological Department (IMD)	New Delhi	24x7x365 (Daily 8 times)	For their day-to-day operational weather forecasting and cyclone warning
		Chennai		
2	National Center for Medium Range Weather Forecasting (NCMWRF)	New Delhi	24x7x365 (Daily 8 times)	This organisation receives buoy data from IMD for validation of their forecasting model
3	Indian Coast Guard	Head Quarters (New Delhi)	24X7X365 (Daily 8 times)	To ensure safety of life at sea as well for their ship operational requirements.
		East (Chennai)		
		West (Mumbai)		
		Andaman (Port Blair)		
4	Indian Navy (Command Met Office)	HQ WNC, Mumbai.	24X7X365 (Daily 8 times)	For their strategic planning and management of operations
		Kochi.		
		Visakhapatnam		
		Port Blair		
5	Indian National Centre for Ocean Information Services (INCOIS)	Hyderabad	24X7X365 (Daily 8 times)	To support Potential Fishing Zone notification and validation of ocean state forecasting model
6	World Meterological Organisation (WMO)	Geneva	-	Data is given in GTS format to IMD to disseminate to WMO for their activates such as understanding global climate and forecast.

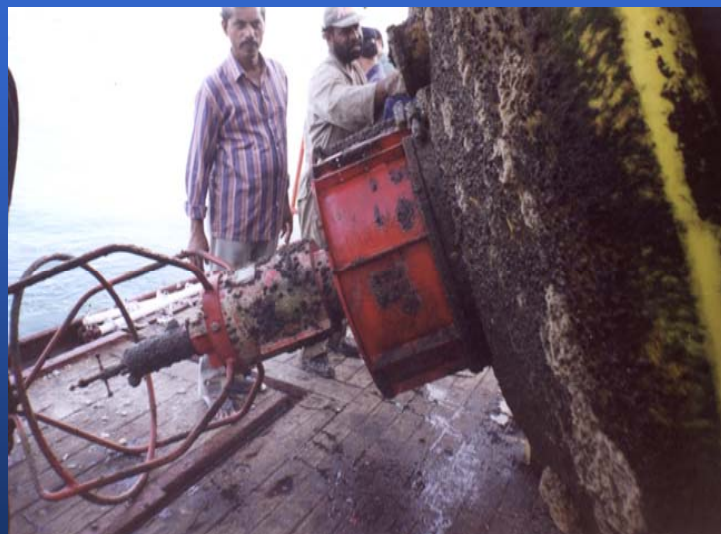
Life Time of Buoys

- Average life time of buoy was 6 to 7 months - Frequent damages due to poor tamper proof design, marine fouling
- In order to overcome this tamper proof features on buoy system incorporated

Damages Due to Vandalism

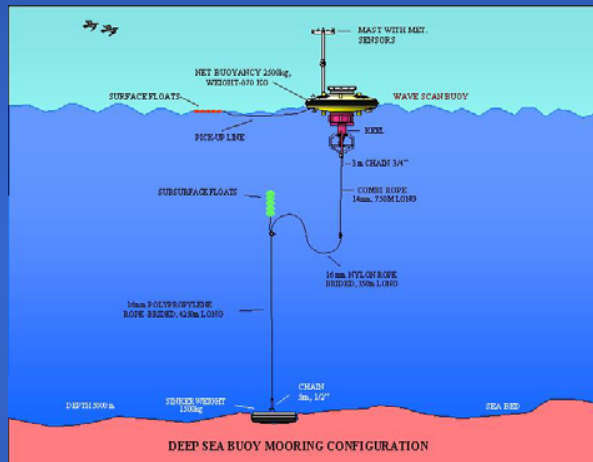


Bio-Fouling



Advancement in Buoy Technology

- Fasteners that cannot be opened with conventional tools
- Solar Panel made flush
- Protective Hood
- All surface floats on mooring submerged



Indigenisation of Buoy Technology

Indigenisation of Buoy Technology

<i>Sl No.</i>	<i>Buoy Components</i>	<i>Present Status of indigenisation</i>
1	Buoy Hull	√
2	Mechanical Components	
	2.1 Instrument Cylinder – Aluminium	√
	2.2 Lid – Aluminium	√
	2.3 Mast, etc. – Aluminium	√
3	Mooring Components	
	3.1 Combination Rope	√
	3.2 Chains, shackles etc.	√
4	Buoy electronics CPU	√
5	SAT Tx	√
6	Sensors	X
7	Beacon Light	√

Indigenisation of Buoy Technology

Mechanical Components



Float



Shackle, Pear ring, Swivel & Chain



Lid Locks



Instrument Cylinder



Keel Frame

Major Indigenised Buoy Components.....



Data Acquisition Unit



Transmitter & Antenna



Beacon Light



Solar Panel

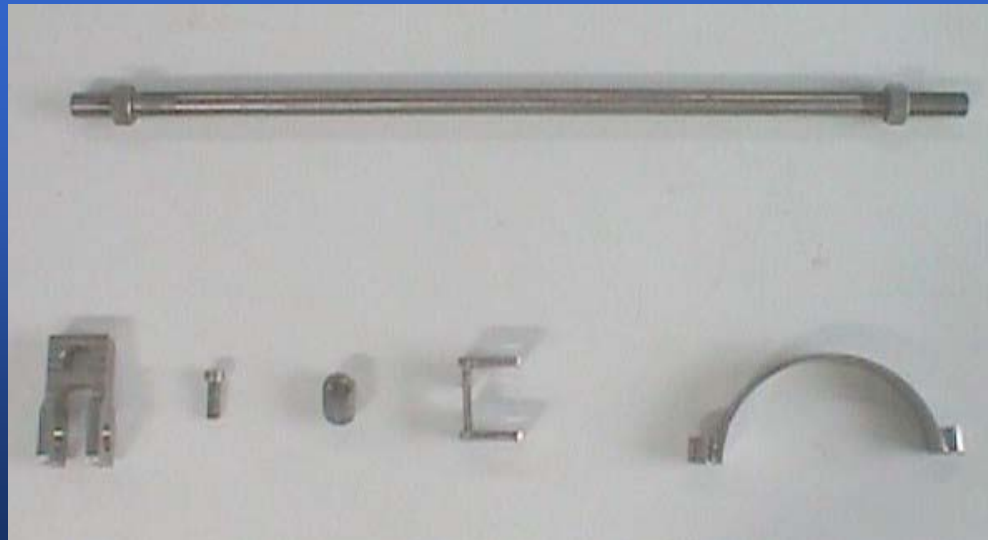
Major Indigenised Buoy Components.....



Battery

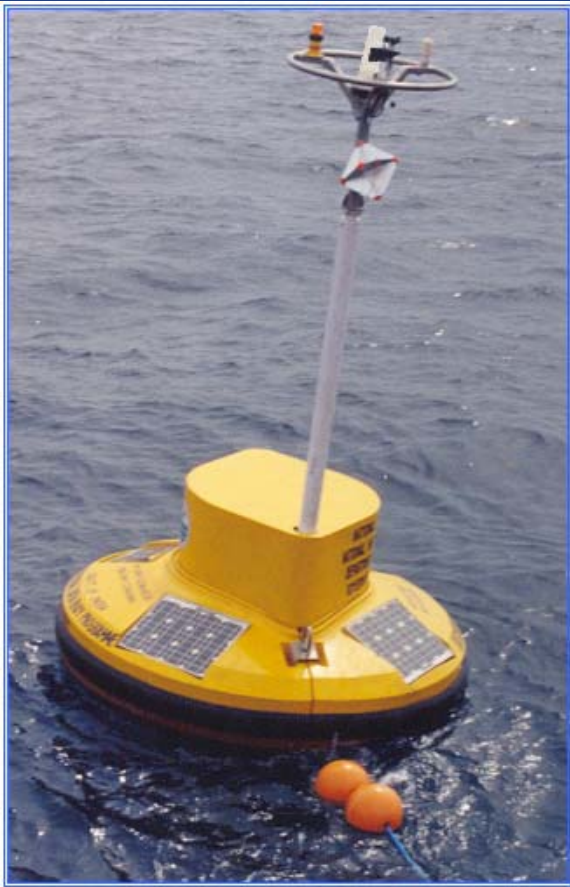


Combination wire rope



Hardware components

Indian Data Buoy (NIOT/DOD Product)



Characteristics:

<i>Diameter</i>	<i>: 2.2 m</i>
<i>Overall height with</i>	<i>: 6.5 m</i>
<i>Weight</i>	<i>: 950 kg.</i>
<i>Reserve Buoyancy</i>	<i>: 2000 kg.</i>
<i>Colour</i>	<i>: Yellow</i>

Met-Ocean Parameters Measured

- ◆ Air Pressure
- ◆ Air Temperature
- ◆ Humidity
- ◆ Wind Speed and Direction
- ◆ Sea Surface Temperature
- ◆ Salinity/Conductivity
- ◆ Current Speed and Direction
- ◆ Wave Parameters include
 - ⊕ Significant wave height.
 - ⊕ Average wave period.
 - ⊕ Average wave direction, whole spectrum.
 - ⊕ Significant wave height, band 'a' (Swell wave height).
 - ⊕ Average wave period, band 'a' (Swell wave period).
 - ⊕ Average direction, band 'a' (Swell wave direction).
 - ⊕ Significant wave height, band 'b' (Sea wave height).
 - ⊕ Average wave period, band 'b' (Sea wave period).
 - ⊕ Average wave direction, band 'b'(Sea wave direction).
 - ⊕ Maximum wave height
 - ⊕ Period of the highest Wave
 - ⊕ Zero crossing wave period

Establishment of 40 Buoy Network

Since 2002 indigenous buoys have been deployed and the target of 40 buoy network was achieved in 2008 in the following stages

<i>Year</i>	<i>No. of buoys in the network</i>
2002	12
2005	20
2007	28
2008	43

Classification of Buoy Network

Ocean Buoys

Sensor Fit

Air Temperature
Humidity
Air Pressure
Wind (speed & direction)
Wave parameters
Current (speed & direction)
SST & Salinity/Conductivity



Simple Met Buoys

Sensor Fit

Air pressure
Humidity
Air Temperature
Wind speed & Direction
SST
Conductivity/Salinity



Environmental Buoys

Sensor Fit

Chlorophyll
Dissolved Oxygen
Conductivity/Salinity
pH
Turbidity
SST



Port/Shallow Water Buoys

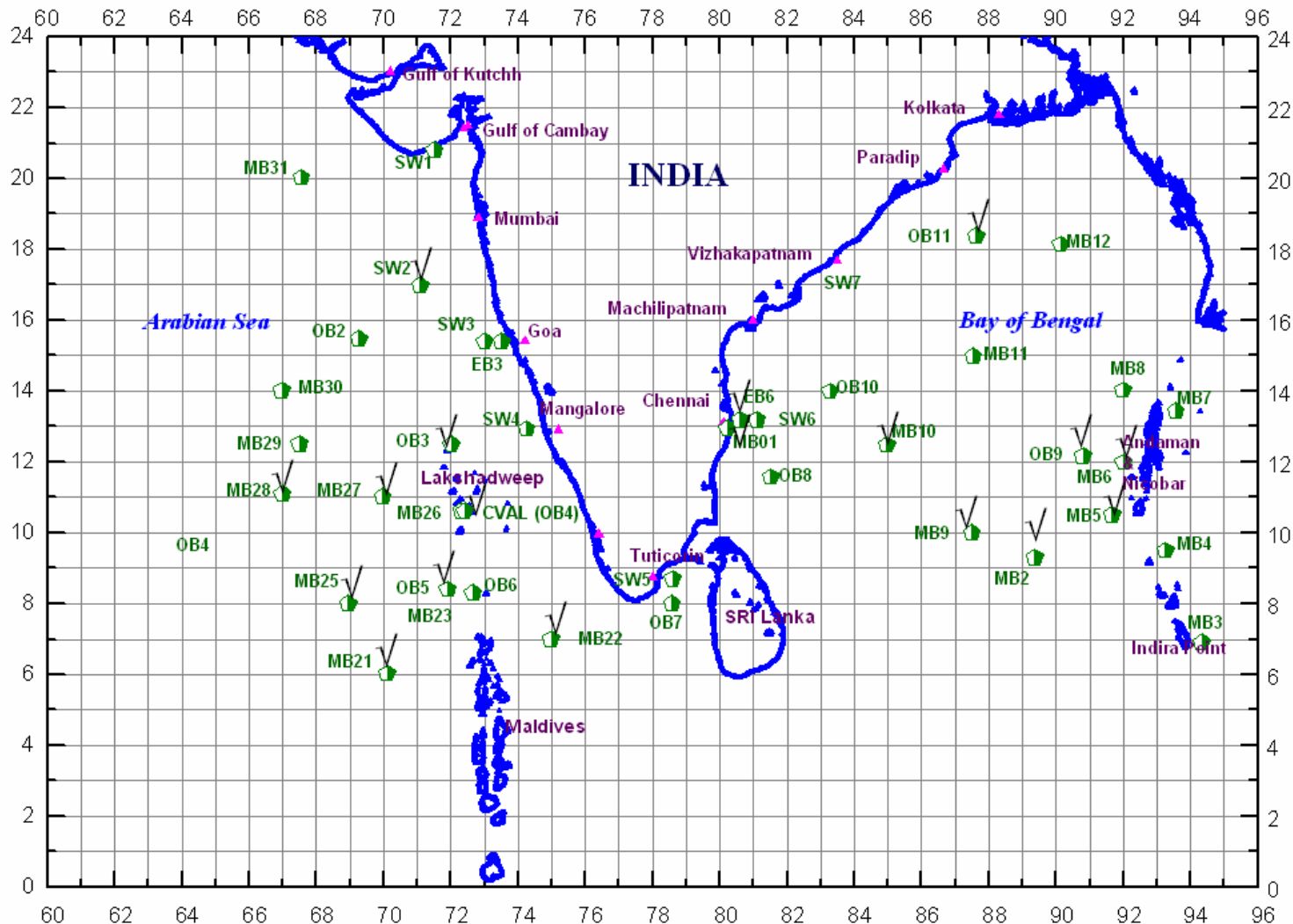
Sensor Fit

Wind speed & direction
Air pressure
Air temperature
SST
Wave
Current speed & direction



Current Buoy Network

43 Moored Buoy Network



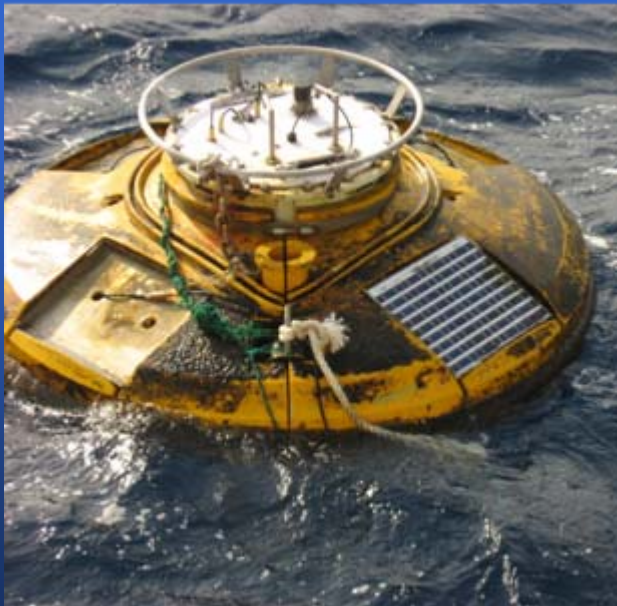
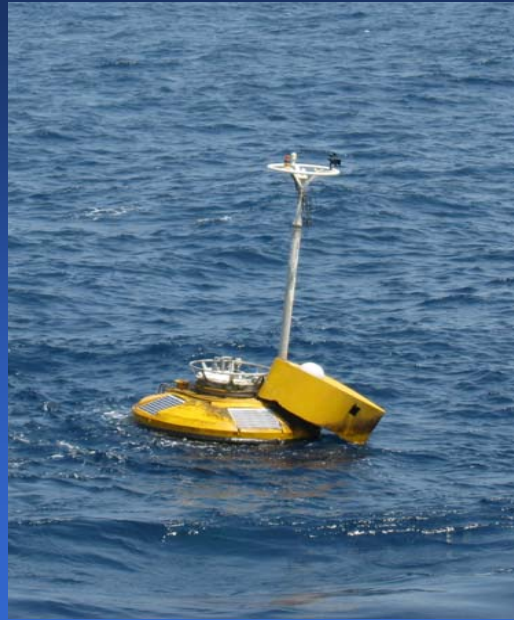
Data Quality

- Data Quality continues to be good
- Continuous measurements are obtained
- Extreme Events were captured and the data was useful for cyclone warning

Life Time of Buoys

- Average life time of buoy continues to be 6 to 7 months only.
Though tamper proof designs were made vandalism continues .

Recent Damages



Details of Buoy Maintenance Carried Out

Year	Deployments	Retrievals	Total
Aug - Dec 1997	8	1	9
Jan - Dec 1998	16	13	38
Jan - Dec 1999	13	13	32
Jan - Dec 2000	20	12	33
Jan - Dec 2001	8	7	15
Jan - Dec 2002	25	11	36
Jan - Dec 2003	23	22	45
Jan - Dec 2004	38	32	70
Jan - Dec 2005	31	26	57
Jan - Dec 2006	34	17	51
Jan - Dec 2007	24	11	35
Jan - Sep 2008	38	2	40
Total	240	165	421

Strategy to Maintain Data from 40 buoys

- In order to achieve data from 40 buoys at any instant it is planned to establish and maintain 100-120 buoy deployment
- Maintenance cruises at regular intervals which is now feasible due to the availability of more vessels with NIOT.
- Creating awareness among fishing community at National/ International level

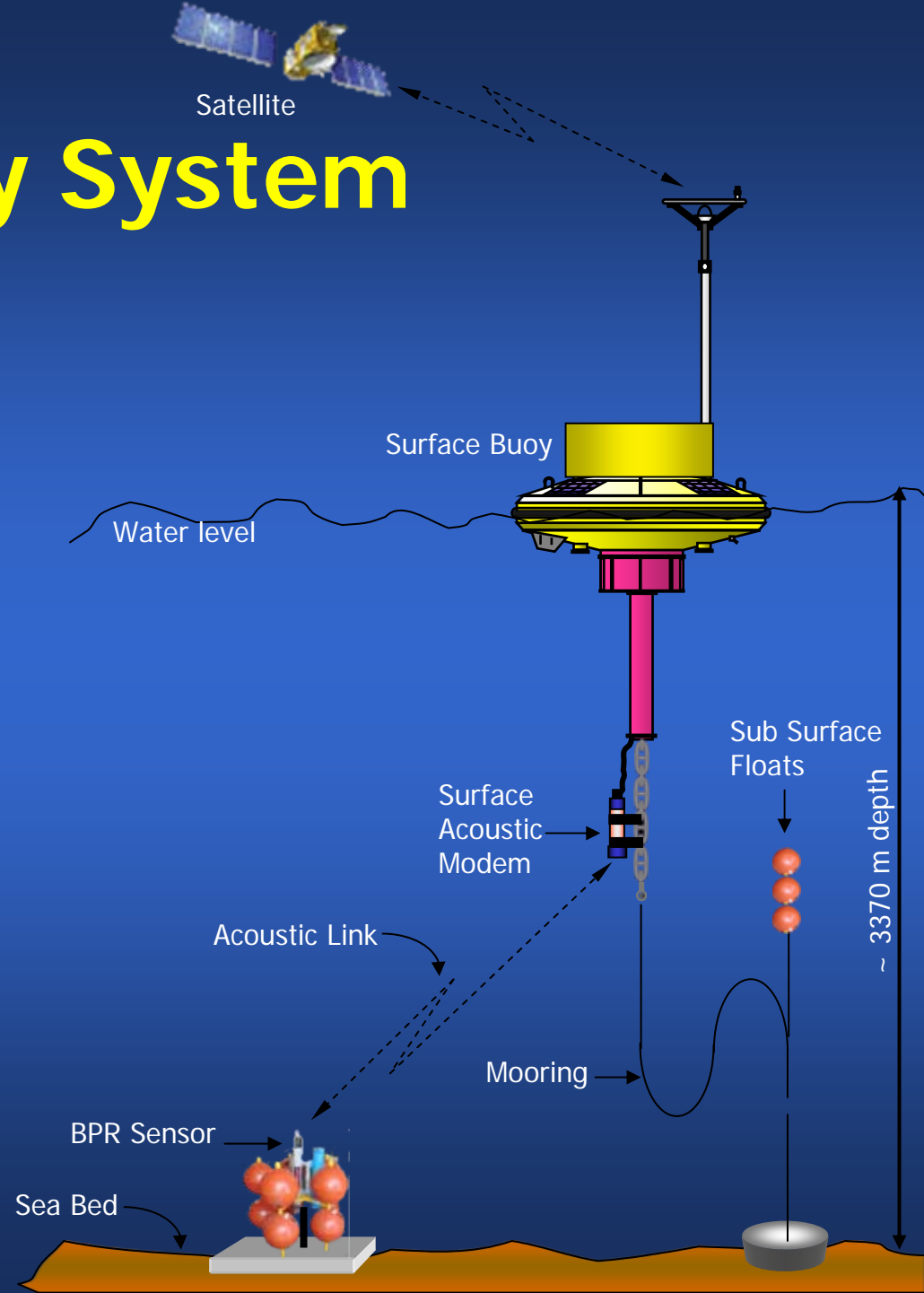
Tsunami System

26th December 2004 -UNFORGETTABLE DAY

Master Plan

On 27th December 2004, NIOT prepared the Master plan to effectively detect and early warn Oceanogenic Disasters around Indian Seas.

Tsunami Buoy System



Bottom Pressure Recorder (BPR) System Selection

Specifications of Requirements drawn for BPR system with following important criteria :

1. Pressure Sensor:

Para scientific quartz pressure sensor, 410 model for a pressure range of 400 bar. The pressure sensor and processing unit are to be tested and calibrated by a NIST accredited laboratory as part of the manufacturing process.

2. Processing unit Software:

NOAA algorithm of DART buoy system

3. Minimum Performance Requirements:

Measurement accuracy	:	0.5 cm or less
Measurement sample rate	:	15 secs.
Measurement processing	:	2 min (or less desirable)

4. Acoustic Modem cum release with built in tilt sensor:

Make	:	Proven
Working range	:	6,000m
Operating frequency	:	9 to 14 kHz
Transducer	:	Omni directional
Slant range	:	10 km.(acoustic release)
Tilt indication when grater than $\pm 25^\circ$ from vertical		

Bottom Pressure Recorder System

NIOT reserved the fund for quick development of BPR system and floated a global tender. Following three (BPR) suppliers emerged

-Envirtech (Italy)

-Fugro Oceanor (Norway)

-Sonardyne (UK)

BPR from

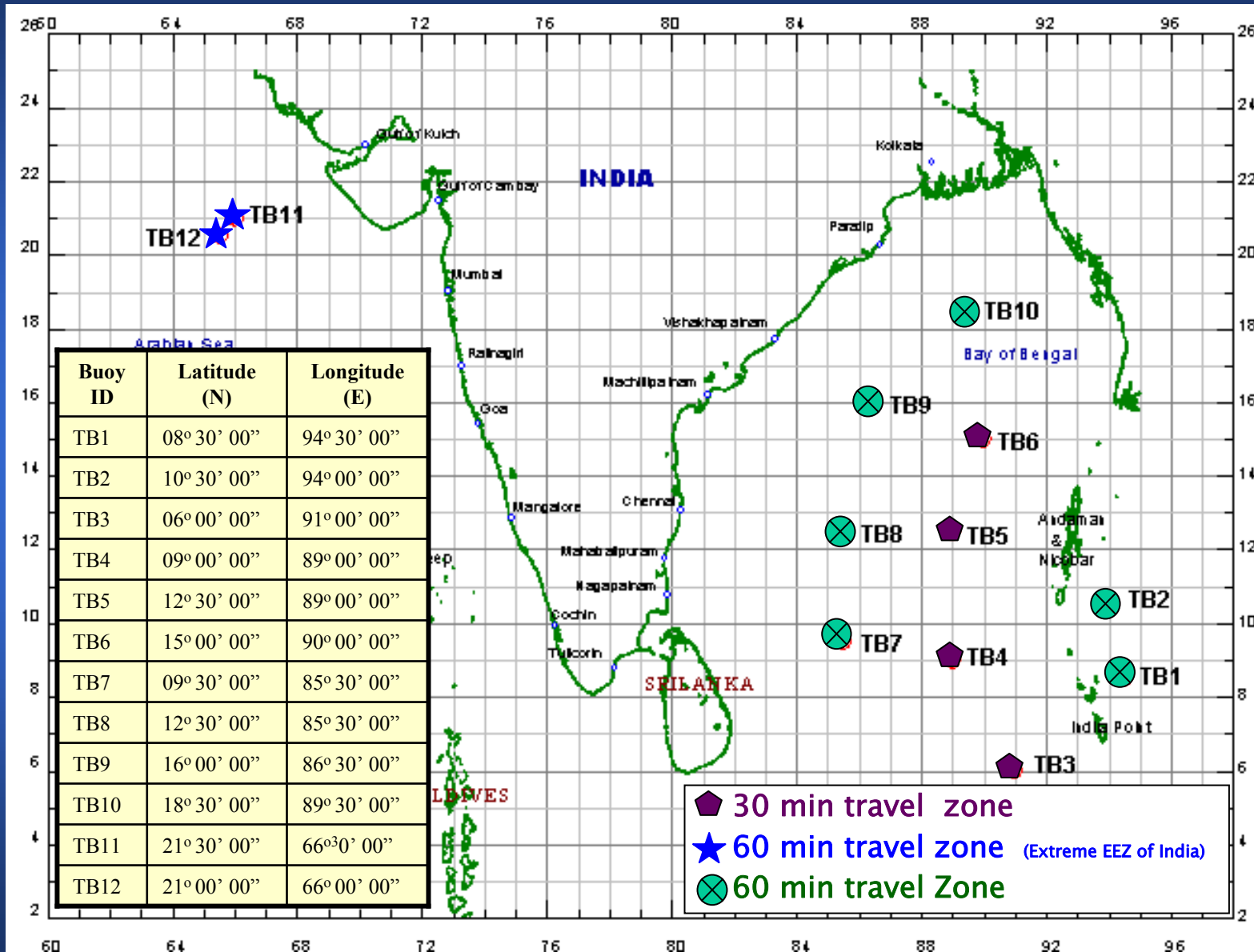


All in one
[Pressure Sensor
BPR Electronics,
Acoustic Modem
& Release
and batteries]

BPR Testing at ATF of NIOT



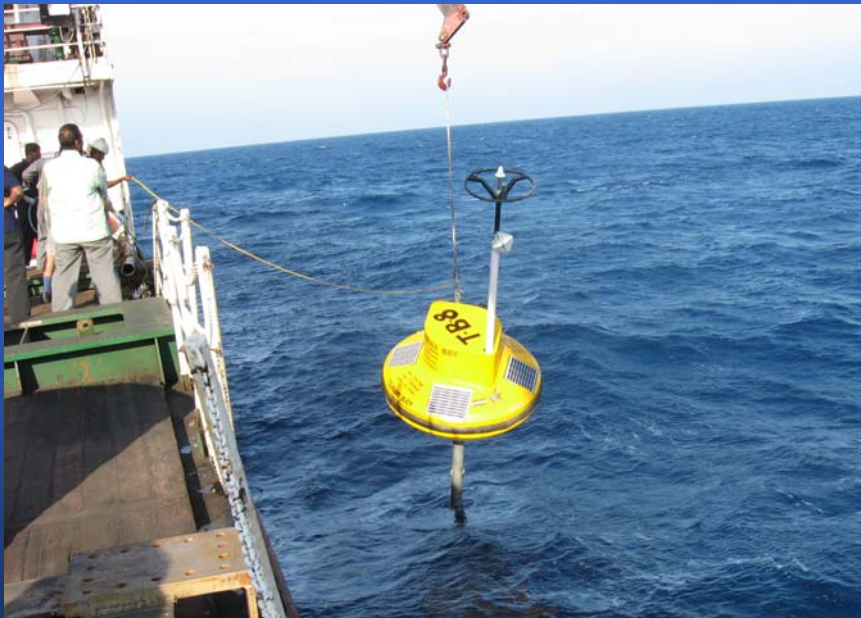
Location for Deep Ocean Tsunami Detection Buoys



Deployment of Tsunami Buoy System

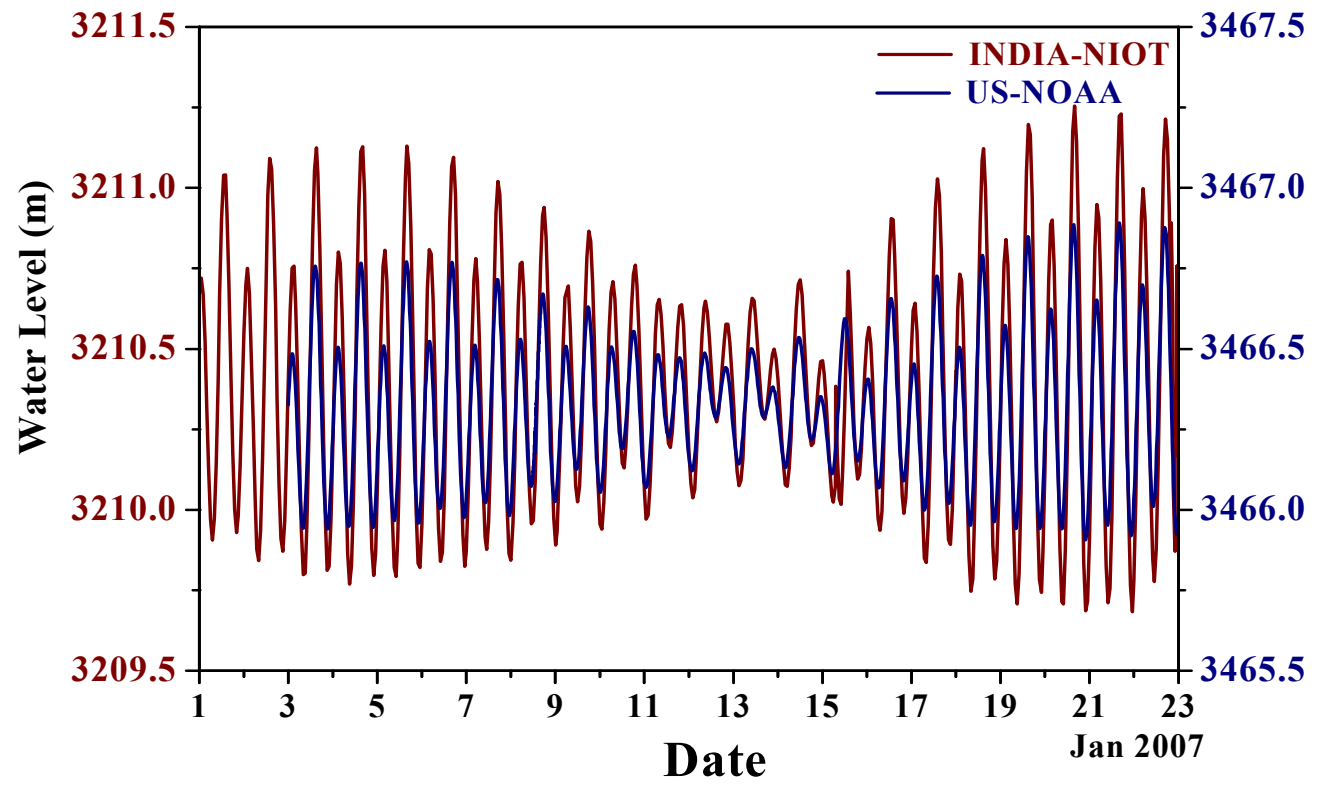
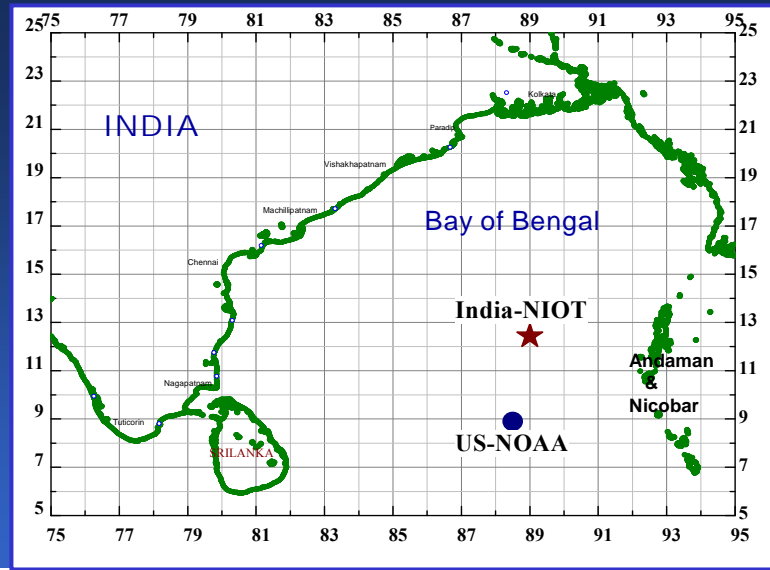


Buoy deployment begins

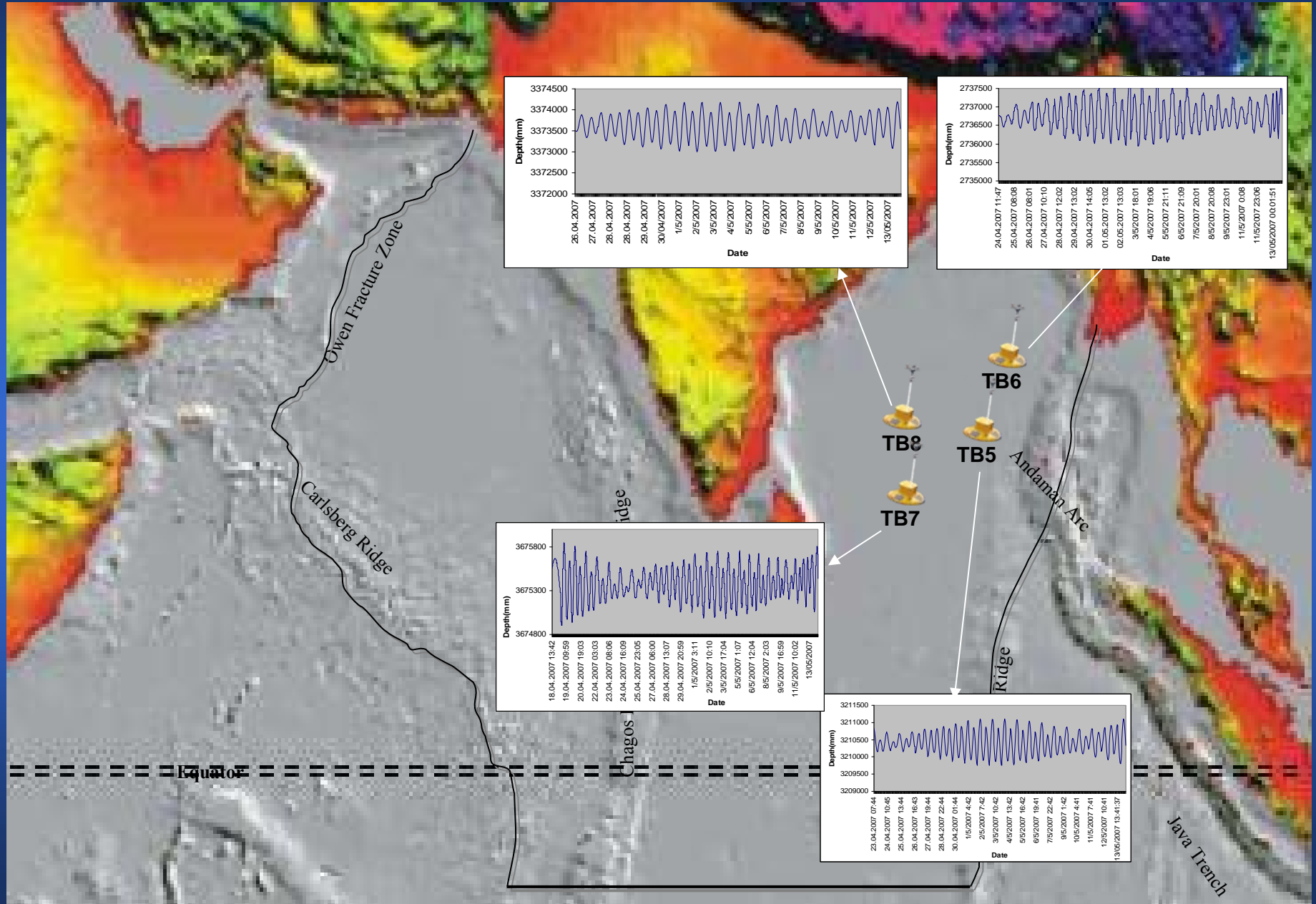


Buoy being lowered on to the sea

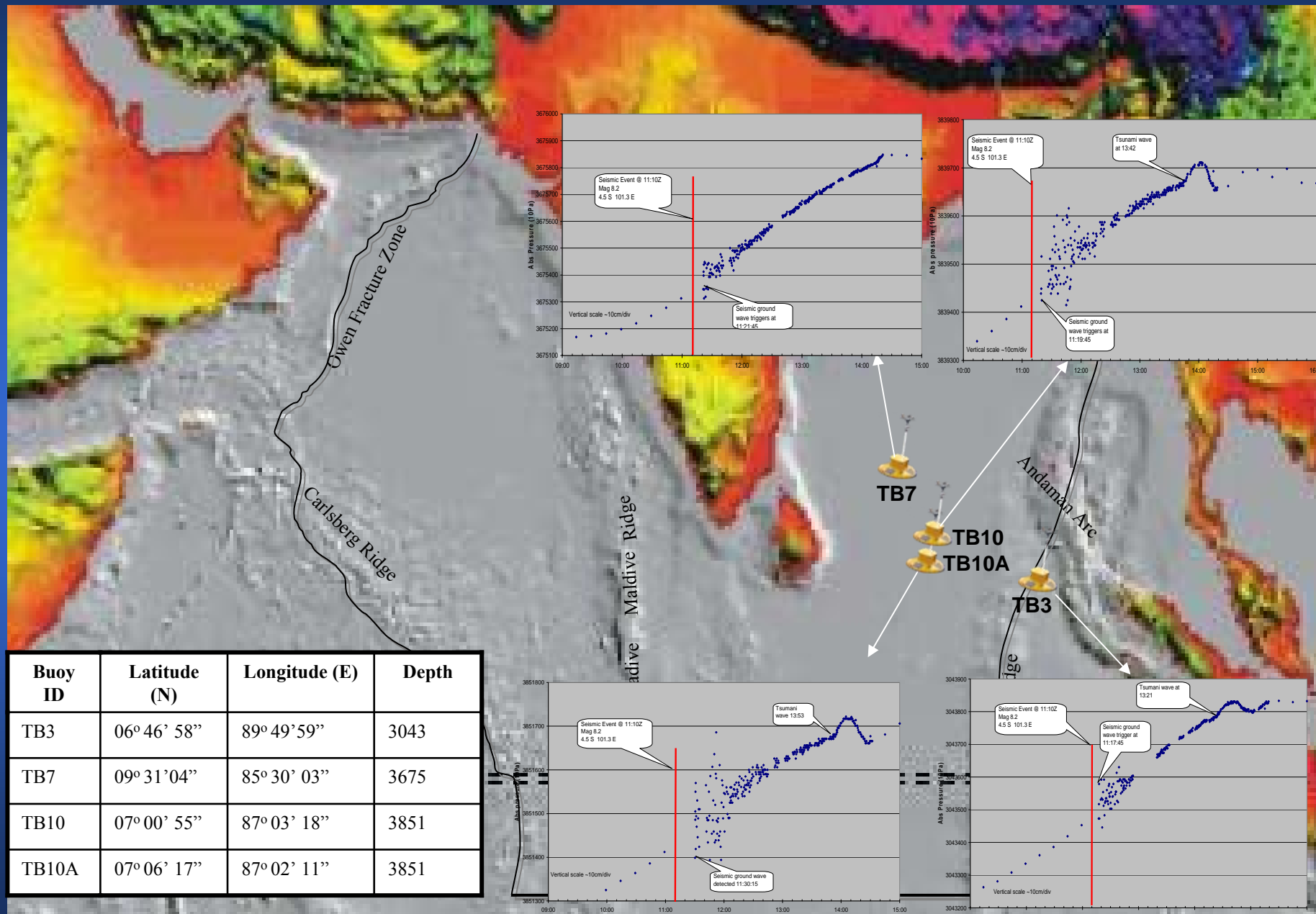
NOAA - NIOT Tsunami Buoys Data



Deep ocean Tsunami Buoys

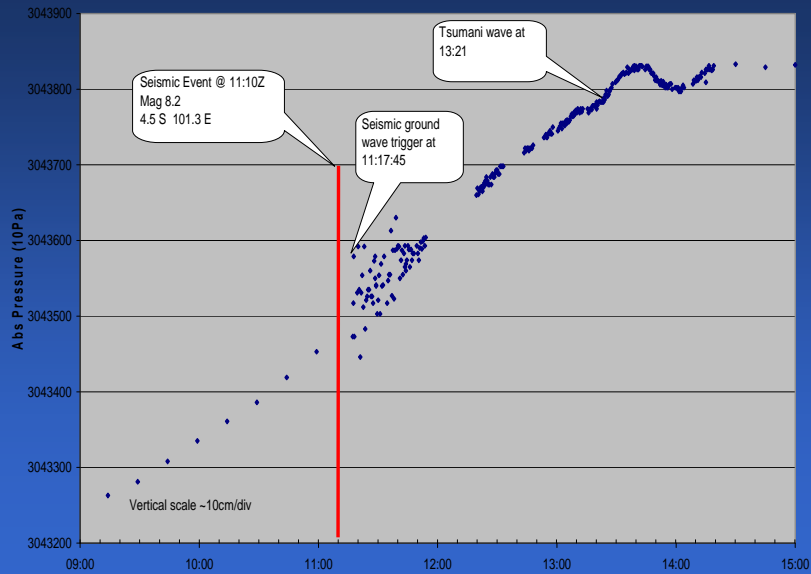


Deep ocean Tsunami Buoys Established in Sep 07

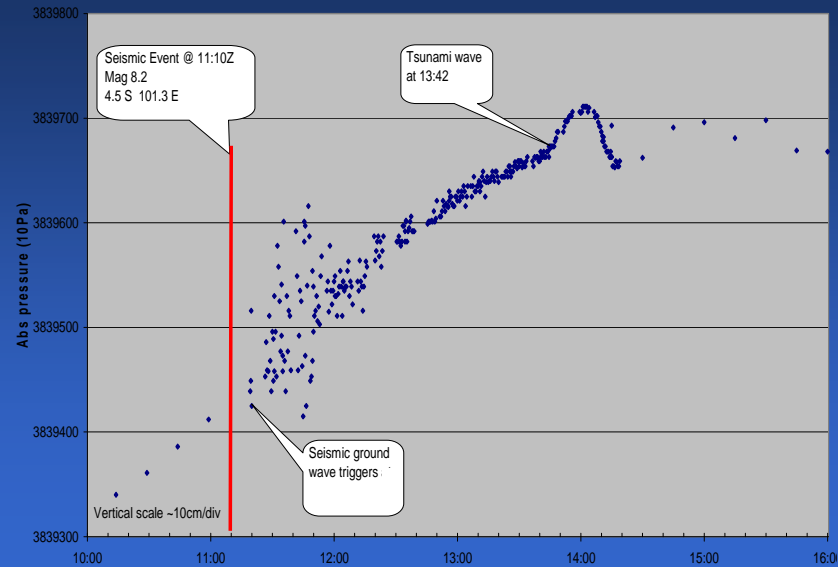


Tsunami Observations

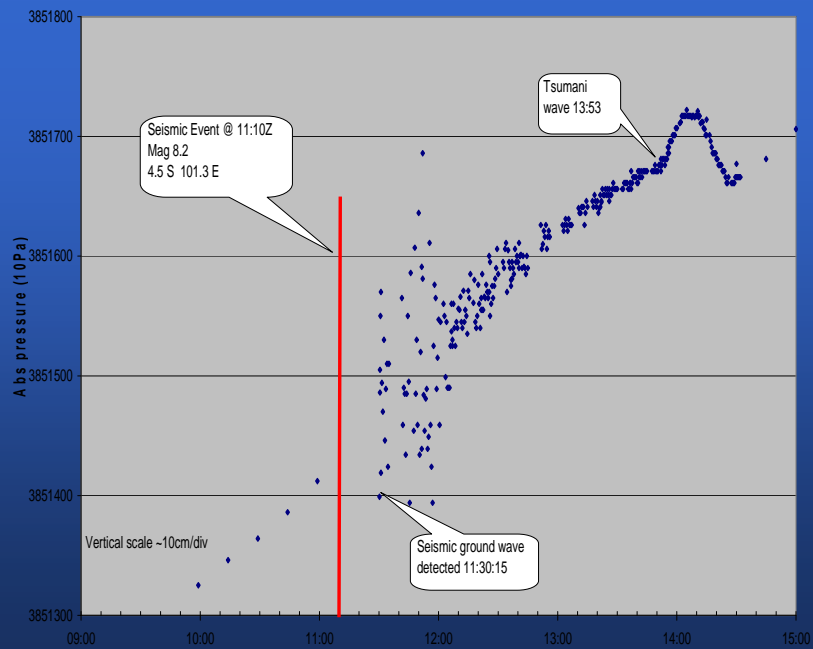
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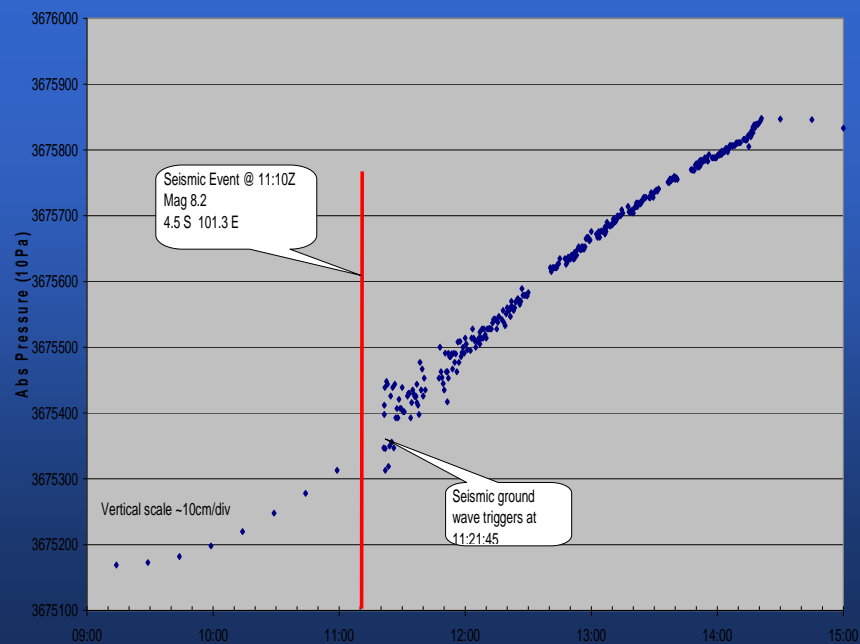
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TB10A



TB07



Thank You